SUBDIVISION OF PORTION OF GRANT 5631
PRELIMINARY SOIL REPORT

WAIOMAO, PALOLO VALLEY, OAHU, HAWAII
TAX MAP KEY: 3-4-36: 5

To:
WATSON LEE, INC.

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

MAY 8, 1973

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

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May 8, 1973

WATSON LEE, INC.
33 South King Street, Room 512
Honolulu, Hawaii 96813

Gentlemen:

Subject: Subdivision of Portion of Grant 5631
Preliminary Soil Report
(for residential development purposes)
Waiomao, Palolo Valley, Oahu, Hawaii
Tax Map Key: 3-4-36: 5

Transmitted herewith is our soil exploration report for residential development purposes for the proposed Subdivision of Portion of Grant 5631 at Waiomao, Palolo Valley, Oahu, Hawaii.

Site grading should generally be kept to a minimum and generally designed with low cuts and minimum fills.

For the light, short-span residential units, post and beam type foundations are generally recommended.

This report includes a Boring Location Sketch, boring logs, laboratory test results, recommendations and limitations.

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

By Ezra Koike
Ezra Koike

EK/FM:rmf

C O N T E N T S

SUBDIVISION OF PORTION OF GRANT 5631
PRELIMINARY SOIL REPORT

WAIOMAO, PALOLO VALLEY, OAHU, HAWAII
TAX MAP KEY: 3-4-36: 5

SCOPE OF EXPLORATION

The purpose of this exploration was to determine general soil conditions for residential development purposes for the proposed Subdivision of Portion of Grant 5631 at Waiomao, Palolo Valley, Oahu, Hawaii.

This report includes field explorations, laboratory tests, general site grading and residential foundation design recommendations and limitations.

FIELD EXPLORATION AND LABORATORY TESTS

Five exploratory borings were made at the site at the approximate locations shown on the Boring Location Sketch. Descriptions of the underlying soils encountered are shown on the boring logs.

Borings were made with 3-in. diameter augers using a finger type bit. Soil samples were recovered with 2-in. o.d. thin-wall tube and standard split spoon samplers driven with a 140-lb hammer falling 30 inches.

Laboratory tests included: natural water content, density and unconfined compression, Atterberg limit, specific gravity, grain-size analysis, AASHO T-180-57 density, expansion and CBR.

GEOLOGIC AND SOIL DESCRIPTIONS BY OTHERS

Stearns, "Geologic and Topographic Map, Island of Oahu, USGS 1938":

Qa - Consolidated deposits, chiefly older alluvium

U. S. Soil Conservation Service, "Soil Survey of Islands of Kauai, Oahu, Maui, Molokai and Lanai, State of Hawaii," August, 1972:

p. 84: Lolekaa silty clay, 15 to 25 percent slopes

(LoD) MH to ML-MH
Low to moderate shrink-swell potential
Susceptible to sliding on steep slopes

Land use Study Bureau, "Oahu Lands Classified by Physical Qualities for Urban Use":

U - Urban area

SOIL CLASSIFICATION SYSTEM

Soil samples were visually observed and subjected to appropriate tests in the laboratory. Based on visual observations and laboratory tests, the soil descriptions given on the boring logs are generally made in accordance with the "Unified Soil Classification System."

GENERAL SITE CONDITIONS

Site Location

The proposed site is located mauka of Waiomao Road and between Halenoho Place and Halelaau Place.

Annual Rainfall

The average rainfall in this area is about 75 to 100 inches annually.

Topography

The site generally slopes downward in a westerly direction at about 20 to 30% gradients with localized variations.

An existing house and several sheds are located in the central portion and western corner of the 1.52 acre site. An existing paved driveway extends into the site for Waiomao Road near the western corner. The A.C. paving is cracked in places probably from erosion and tree roots.

The upper portion of the site is overgrown with grass, weeds and trees along the eastern boundary. Fruit trees and plants cover most of the central and western sections. The lower portion adjacent to Waiomao Road is covered by tall trees.

Existing residential houses border the north and south boundaries.

INTERPRETATION OF SOIL CONDITIONS

From the field explorations and laboratory test results, the soils encountered in the borings may be generally approximated as follows:

Medium to stiff silty clay with decomposed rock and some pockets of clays to about 16 to 21 ft, the depths drilled.

Water was not noted in the borings during the field explorations.

Variations to the above soil conditions are to be expected in localized areas. For more detailed descriptions of soils encountered in the borings, refer to the boring logs.

DISCUSSION AND RECOMMENDATIONS

In general, the present plan is to clear and grade the site for residential development.

The preliminary plan generally indicates that the site will be graded by excavating terraced lots. Some low slopes and retaining walls are also planned.

Because existing residential houses and some retaining walls border the north boundary, grading work should be done carefully to minimize disturbance to the existing wall along the boundary. The tops of slopes should be kept away from the boundary in accordance with the requirements of the grading ordinance.

Buildings proposed along the northern and eastern areas should be designed so that excavations do not cut into the toe of the slope.

Buildings proposed along the southern half of the site should be kept about 15 ft or more away from the top of slope along the boundary

where some low walls have been constructed at the toes of slopes for the rear yards of existing dwellings.

Because an existing house is on the site, concrete footings, rubble and abandoned utility lines and cesspools may underlie the surface. To minimize hard and soft spots, concrete footings, rubble and abandoned utility lines should be removed and the excavation backfilled with select material.

Site Grading

Grading of the site should be done in accordance with Chapter 23, Revised Ordinances of Honolulu, 1969 As Amended and the recommendations contained herein:

1. The area should be cleared and grubbed. Surface vegetation and miscellaneous debris should be cleared and removed prior to site filling.

2. Existing trees in the lower portion of the site should be removed. The excavations from root removal should be backfilled with selected on-site soils compacted in thin level layers to match the density of the surrounding ground.

3. Loose surface soils should be stripped to stiff natural ground before the placement of fills. Loose surface soils at finish grade should be scarified and recompacted.

4. Localized soft pockets or pockets of clays encountered during the site preparation should be excavated and replaced with compacted select material.

5. Thin sidehill fills (sliver fills) on sloping areas should be avoided.

6. Subdrains should be placed along the bottom of natural drainage paths and in localized wet spots to provide drainage paths to storm drain systems.

7. Fills (if any) should be constructed in approximately level layers starting at the lower end and working upward. Where fills are made on sloping areas steeper than about 5 horizontal to 1 vertical, the ground at the toe of the fill should be benched to a generally level condition. As the fill is

brought up, it should continually be keyed into stiff natural ground by cutting steps into the slopes and compacting the fill into these steps.

8. Fills should be laid in 6-in. compacted layers to 90% of the maximum density determined by the AASHO T-180-57 test method.

9. The on-site soils from the deeper cut areas with relatively high water contents may be difficult to compact.

   When used for the construction of fills, these soils should be compacted in one-foot layers to the maximum density obtainable in the laboratory at the water content approximating the field moisture condition. In addition, the relative density of the compacted soil should be greater than 85% of AASHO Test No. T-180-57.

10. Provisions should be included to drain the site during and after filling operations.

Slopes

In general, cut and fill slopes of 2 horizontal to 1 vertical or flatter should be used.

Slope heights (top to toe) should generally be about 10 ft or less, if practicable.

To minimize erosion, the runoff from rainstorms should be diverted away from slopes by berms or ditches whenever practicable.

The surface of fill slopes (if any) should be compacted by cat-tracking or with a sheepsfoot roller.

Slope planting is recommended on cut and fill slopes to minimize erosion.

A contingency should be allowed in the contract documents for slope adjustments or other precautions if seepage zones, expansive clay pockets or soft spots are encountered in localized areas.

Foundations

General recommendations for foundation design are as follows:

1. For the proposed light, short span, residential units, post and beam type footings are generally recommended at this site.

2. Bearing values of 2000 p.s.f. may be used for footings resting on stiff natural ground or on compacted fill.

3. Soft spots, expansive soils or pockets of loose material encountered at bottom of footing excavations or below the building area should be excavated and replaced with well-graded granular material such as coral or other approved material.

4. Because of the downhill creep effect of soils on a slope, some settlements may occur near the tops of slopes. Buildings should generally be placed about 15 ft from the tops of slopes. This distance may be reduced for lower slope heights, e.g., 10 ft for 10-ft-high slopes, but generally not closer than 5 ft from the top of any slope.

5. Construction of retaining walls on slopes should generally be avoided.

6. Good surface drainage away from the foundations of structures should be maintained and the site should be graded to prevent the ponding of water.

Retaining Wall

Where retaining walls are unavoidable, they should be kept as low as practicable and generally less than about 6 ft in height.

In general, flexible gravity walls are recommended.

The base of the wall should be at least 2 ft below the finished grade on the lower side of the wall and should bear on stiff ground.

If a footing is located over or near a utility trench, the bottom of the footing should extend below the bottom of the trench.

Soft pockets or pockets of "CH" clay encountered in footing excavations should be removed and replaced with select well-graded granular material compacted in thin level layers to at least 90% of AASHO T-180-57 density.

A bearing value of about 3000 p.s.f. may be used for the base of wall on stiff natural ground.

Fairly well-graded granular material or select granular material should be used for backfilling against the wall.

A lateral earth pressure of about 45 p.c.f. equivalent fluid pressure may be used to design retaining walls less than 6 to 8 ft in height.

Good drainage away from the foundation should be provided and the site should be graded to avoid ponding of water next to the wall. A subdrain should be placed behind the base of the wall to minimize trapping of water.

Roadway

In general, for light automobile traffic and drained subgrade conditions, an estimate of roadway pavement thickness is as follows:

1. Wearing course - 2-in. asphaltic concrete.
2. Base course - 6-in. base course.
3. Subbase course - 6-in. select material over a prepared subgrade.

Provisions should be made in the contract documents to allow for local adjustments regarding select borrow subbase and borrow material requirements in the field in accordance with the design standards of the City and County of Honolulu. In fill areas, the use of select soils within the top 2 to 3 ft of the subgrade may reduce the thickness of or eliminate the need for the select borrow subbase or borrow courses.

Concrete paving should be designed in general conformance with the design standards of the City and County of Honolulu.

The subgrade should be compacted and shaped to drain. To avoid the ponding of water and softening of the subgrade at low points, weep holes should be placed at subgrade levels thru the walls of the catch basins which are placed in these low areas.

Existing Cesspools

If cesspools are encountered, they should be accurately located in the field, marked on the plans and backfilled under controlled conditions.

Before backfilling, sludge should be removed from the bottom of the cesspool. Backfill material should generally be fairly well-graded granular material. The materials should be placed in thin level layers and rammed into place or compacted with vibratory equipment. The top 3 ft should be constructed with soils similar to the surrounding soils and should be constructed in 6-in. compacted layers.

Utilities

Utilities should be placed after the fills are constructed and designed with flexible joints, particularly where lines are connected to structures.

Subdrains or filter material should be placed at the bottom of trenches to provide drainage paths that daylight at low points.

Unforeseen Conditions

Unforeseen or undetected conditions such as soft spots, seepage water or expansive soil pockets may occur in localized areas and will have to be adjusted and corrected in the field as they are detected.

Site Regrading

After mass grading work is done and cuts and fills are made according to the grading plans, regrading at some future date should be avoided unless done under the guidance of a Soils Engineer.

PROPOSED SPECIFICATION FOR EARTHWORK

SUBDIVISION OF PORTION OF GRANT 5631

General Description

This item shall consist of clearing and grubbing, preparing of land to be filled, excavating and filling of the land, spreading, compacting and testing of the fill, and subsidiary work necessary for grading the site.

Clearing, Grubbing and Preparing Areas to be Filled

Vegetation, rubbish and miscellaneous material shall be removed and disposed of, leaving the disturbed area with a neat, debris-free appearance.

Loose surface and stockpiled soils shall be stripped to stiff natural ground before the placement of fills. Loose surface soils encountered at finish grade shall be scarified and recompacted.

Materials

Fill material shall consist of selected on-site soils or approved borrow soils. The soils shall contain no more than a trace of organic and deleterious matter.

Borrow soils shall be select soils generally less than 3-in. maximum size, with more than 30% fines and a plasticity index generally less than 20.

Fill material placed in the top 2 ft of fills shall contain less than 30% gravel.

Placing, Spreading and Compacting Fill Material

The selected fill material shall be placed in level layers which, when compacted, shall not exceed 6 inches. Each layer shall be spread evenly and thoroughly blade-mixed during the spreading to attain uniformity of material and water content within each layer.

Rocks or cobbles shall not be allowed to nest and voids between rocks shall be carefully filled and compacted with small stones or earth.

When the water content of the fill material is well below the optimum for compacting purposes, water shall be added until the water content is near optimum.

When the water content of the material is well above the optimum for compacting purposes, the fill material shall be aerated by blading or by other satisfactory methods until the water content is near the optimum.

After each layer has been placed, mixed and spread evenly, it shall be compacted to 90% of maximum density in accordance with AASHO Test No. T-180-57 or other comparable density tests. Compaction shall be with sheepsfoot rollers, multiple-wheel pneumatic-tired rollers or other acceptable rollers which shall be able to compact the fill to the specified density. Rolling shall be accomplished while the fill material is at the specified water content. The rolling of each layer shall be continuous over its entire area and the roller shall make sufficient passes to obtain the desired density.

Field density tests shall be made to get an indication of the compaction of the fill. Where sheepsfoot rollers are used, the soil may be disturbed to a depth of several inches. Density readings shall be taken as often as necessary in the compacted material below the disturbed surface. When these readings indicate that the density of any layer of fill or portion thereof is below the required 90% density, that layer or portion shall be reworked until the required density has been obtained.

The fill operation shall be continued in 6-in. compacted layers, as specified above, until the fill has been brought to the finished slopes and grades as shown on the accepted plans.

Compaction of High Moisture Fill Material

The on-site soils from the deeper cut areas with relatively high water contents may be difficult to compact.

When used for the construction of fills, these soils shall be compacted in one-foot layers to the maximum density obtainable in the laboratory at the water content approximating the field moisture condition. In addition, the relative density of the compacted soil shall be greater than 85% of AASHO Test No. T-180-57.

Backfilling of Old Cesspools

The following procedures shall be followed for backfilling:

(1) Sludge Removal

Remove the sludge from the bottom of the old cesspool by (a) pumping or (b) by clamshell or any other suitable

way. The material shall be disposed of away from the site. The completeness of removal shall be verified by probing and the sludge shall be less than 12 in. at the bottom.

(2) Granular Fill (below 3 ft from finish grade)

Use granular material, graded from 6 to 0 inches. The fines passing the No. 200 sieve shall be less than 10%. The materials shall be placed in thin layers (12 in. maximum) and compacted with vibratory equipment to 90% of AASHO T-180-57 density. Ramming each layer into place with a clamshell bucket will be allowed. The granular fill shall be wetted before placement into the cesspools. Sufficient compaction tests shall be conducted to verify that 90% compaction is obtained by the construction method selected.

(3) Top 3 Ft of Fill

Linings encountered in the cesspools within the top 3 ft from finish grade shall be removed. The fill within the top 3 ft from finish grade shall be constructed from on-site soil in thin layers (6-in. compacted thickness) to 90% of AASHO T-180-57 density. The material at finish grade shall blend with the surrounding soil.

Excavation

Suitable material from excavation shall be used in the fill and unsuitable material from excavation shall be disposed of.

Unforeseen Conditions

If unforeseen or undetected critical soil conditions such as soft spots, seepage water or expansive soil pockets are encountered, corrective measures shall be made in the field as they are detected.

Rainy Weather

Fill material shall not be placed, spread or rolled during unfavorable weather conditions. When the work is interrupted by heavy rain, fill operations shall not be resumed until field tests indicate that the water content and density are as previously specified.

BORING LOGS

The stratification lines shown on each of the boring logs represent the approximate boundary between soil types and the transition may be gradual. .

Symbols

Symbols used generally are in accordance with the Unified Soil Classification System.

Where a parenthesis "(MH)" is used, the soil sample was classified by visual observation of the sample recovered.

Where no parenthesis "MH" is used, the soil sample was classified from either the Atterberg limit or sieve analysis test results.

PORT. GRANT 5631

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT SUBDIVISION OF PORTION OF GRANT 5631

LOCATION WAIOMAO, PALOLO VALLEY, OAHU, HAWAII

TAX MAP KEY: 3-4-36: 5

HAMMER:
Weight 140#
Drop 30"

SAMPLER: 2"SS - 2" O.D. THIN WALL TUBE
2"SS - 2" STANDARD SPLIT SPOON

BORING NO. 1 Sheet No. ____ of ____

Driller W. LUM ASSOC., INC. Date APR. 10, 1973

Field Party KADOVICH, SETO, CHOW

Type of Boring AUGER (MOBILE MINUTEMAN) Diam. 3"

Elev. 487'± * Datum —

Drill Bit FINGER TYPE

Water Level	NOT NOTICED			
Time	—			
Date	4-10-73			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test N (Blows per foot) 0 10 20 30 40	PENETRATION DATA: 2" O.D. THIN WALL TUBE SAMPLER BLOWS/0.5'
	ELEV.: 487'±↓ *	0									
(MH)	STIFF, REDDISH BROWN SILTY CLAY W/TRACES OF ROOTS		2"SS	1-A	–	48	–	–	–		
		5	2"S	1-B	117	54	76	–	–		3/0.5' 6/0.5'
(MH)	STIFF, MOTTLED GRAY & REDDISH BROWN SILTY CLAY W/DECOMPOSED ROCK	10	2"SS	1-C	–	45	–	–	–		
(MH)	MEDIUM TO STIFF MOTTLED BROWN CLAYEY SILT W/DECOMPOSED ROCK	15	2"S	1-D	90	46	61	–	–		4/0.5' 5/0.5'
(MH)	STIFF MOTTLED BROWN & GRAY SILTY CLAY W/TRACES OF SAND	20	2"SS	1-E	–	53	–	–	–		
	END OF BORING @ 21.5'										

*Elev. Estimated from Topographic Survey

PORTION GRANT 5631

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT SUBDIVISION OF PORTION OF GRANT 5631

LOCATION WAIOMAO, PALOLO VALLEY, OAHU, HAWAII

TAX MAP KEY: 3-4-36: 5

HAMMER:
Weight 140#
Drop 30"

SAMPLER: 2" S-2" O.D. THIN WALL TUBE
2" SS-2" STANDARD SPLIT SPOON

BORING NO. 2 Sheet No. ____ of ____

Driller W. LUM ASSOC., INC. Date APR. 11, 1973

Field Party RADOVICH, CHOW, REYNALDS

Type of Boring AUGER (MOBILE MINUTEMAN) Diam. 3"

Elev. 509'± * Datum –

Drill Bit FINGER TYPE

Water Level				
Time	–			
Date	4-11-73			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test N (Blows per foot) 0 10 20 30 40	PENETRATION DATA: 2" O.D. THIN WALL TUBE SAMPLER BLOWS/0.5'
	ELEV.± 509'± *	0									
(MH)	STIFF, MOTTLED DARK BROWN SILTY CLAY W/ ROOTS		2"SS	2-A	–	51 49	–	–	–		
(MH)	STIFF, REDDISH BROWN SILTY CLAY	5	2"S	2-B	107	50	71	–	–		7/0.5' 9/0.5'
(MH-CH)	MEDIUM TO STIFF MOTTLED REDDISH BROWN SILTY CLAY W/ DECOMPOSED ROCK	10	2"SS	2-C	–	50	–	–	–		
		15	2"S	2-D	113	63 53	69	–	–		3/0.5' 4/0.5'
MH	STIFF, MOTTLED DARK BROWN SILTY CLAY W/ DECOMPOSED ROCK	20	2"SS	2-E	–	49	–	–	–		
	END OF BORING @ 21.5'						LL= 99 PL= 45				

NOTE:
LL= LIQUID LIMIT, %
PL= PLASTIC LIMIT, %

*Elev. Estimated from Topographic Survey

PORTION GRANT 5631

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT SUBDIVISION OF PORTION OF GRANT 5631

LOCATION WAIOMAO, PALOLO VALLEY, OAHU, HAWAII

TAX MAP KEY: 3-4-36: 5

BORING NO. 3 Sheet No. ____ of ____

Driller W. LUM ASSOC., INC. Date APR. 12, 1973

Field Party RADOVICH, CHOW, REYNALDS

Type of Boring AUGER (MOBILE MINUTEMAN) Diam. 3"

Elev. 523'± * Datum —

Drill Bit FINGER TYPE

Water Level NOT NOTICED

Time —

Date 4-12-73

HAMMER:
Weight 140#
Drop 30"

SAMPLER: 2"SS-2" O.D. THIN WALL TUBE
2"SS-2" STANDARD SPLIT SPOON

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test N (Blows per foot) 0 10 20 30 40	PENETRATION DATA: 2" O.D. THIN WALL TUBE SAMPLER BLOWS/0.5'
	ELEV. = 523'± *	0									
MH	STIFF, MOTTLED RED BROWN SILTY CLAY W/GRAY CLAY POCKETS		2"SS	3-A	—	43	—	—	—		
		5	2"S	3-B	115	44	80	6200	—		5/0.5' 9/0.5'
							LL= 97				
							PL= 43				
MH	STIFF MOTTLED BROWN & GRAY SILTY CLAY W/TRACES OF SAND	10	2"SS	3-C	—	56	—	—	—		
							LL= 116				
							PL= 47				
MH	STIFF, MOTTLED BROWN & GRAY SILTY CLAY W/DECOMPOSED ROCK	15	2"S	3-D	108	50	72	—	—		5/0.5' 5/0.5'
							LL= 83				
							PL= 42				
MH	MEDIUM TO STIFF MOTTLED BROWN & GRAY CLAYEY SILT W/DECOMPOSED ROCK	20	2"SS	3-E	—	58	—	—	—		
							LL= 78				
							PL= 40				
	END OF BORING @ 21.5'										

NOTE:
LL= LIQUID LIMIT, %
PL= PLASTIC LIMIT, %

*Elev. Estimated from Topographic Survey

PORT GRANT 5631

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT SUBDIVISION OF PORTION OF GRANT 5631

LOCATION WAIOMAO, PALOLO VALLEY, OAHU, HAWAII
TAX MAP KEY: 3-4-36: 5

BORING NO. 4 Sheet No. ____ of ____

Driller W. LUM ASSOC., INC. Date APR. 10, 1973

Field Party RADOVICH, SETO, CHOW

Type of Boring AUGER (MOBILE MINUTEMAN) Diam. 3"

Elev. 487'± * Datum —

Drill Bit FINGER TYPE

Water Level NOT NOTICED

Time —

Date 4-10-73

HAMMER:
Weight 140#
Drop 30"

SAMPLER: 2"SS - 2" O.D THIN WALL TUBE
2"SS - 2" STANDARD SPLIT SPOON

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test N (Blows per foot) 0 10 20 30 40	PENETRATION DATA: 2" O.D. THIN WALL TUBE SAMPLER BLOWS/0.5'
	ELEV. = 487'± *	0									
(MH)	STIFF, MOTTLED BROWN CLAYEY SILT W/ DECOMPOSED ROCK & ROOTS		2"SS	4-A	—	41	—	—	—		
(MH)	STIFF MOTTLED REDDISH BROWN SILTY CLAY W/ DECOMPOSED ROCK	5	2"S	4-B	109	46	75	3,060	—		4/0.5' 5/0.5'
(MH)	STIFF MOTTLED DARK BROWN CLAYEY SILT W/ DECOMPOSED ROCK & SOME SAND	10	2"SS	4-C	—	52	—	—	—		
	END OF BORING @ 16'	15	2"SS	4-D	—	42	—	—	—		9/0.5'

*Elev. Estimated from Topographic Survey

PORTION GRANT 5631

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT SUBDIVISION OF PORTION OF GRANT 5631

LOCATION WAIOMAO, PALOLO VALLEY, OAHU, HAWAII

TAX MAP KEY: 3-4-36: 5

BORING NO. 5 Sheet No. ____ of ____

Driller W. LUM ASSOC., INC. Date APR. 11 & 12, 1973

Field Party RADOVICH, CHOW, REYNALDS

Type of Boring AUGER (MOBILE MINUTEMAN) Diam. 3"

Elev. 501' ± * Datum —

Drill Bit FINGER TYPE

Water Level NOT NOTICED

Time —

Date 4-12-73

HAMMER:
Weight 140#
Drop 30"

SAMPLER: 2"SS-2" STANDARD SPLIT SPOON
2" S-2" O.D. THIN WALL TUBE

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Wet Dens. P.C.F.	Water Cont. %	Dry Dens. P.C.F.	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test N (Blows per foot) 0 10 20 30 40	PENETRATION DATA: 2" O.D. THIN WALL TUBE SAMPLER BLOWS/0.5'
	ELEV. = 501' ± *	0									
CH	STIFF MOTTLED GRAY BROWN CLAY W/ROOTS		2"SS	S-A	-	44	- LL= 107 PL= 41	-	-		
		5									
CH	STIFF MOTTLED RED BROWN & GRAY CLAY		2"S	S-B	118	43	82 LL= 112 PL= 39	6420	-		5/0.5' 6/0.5'
		10									
			2"SS	S-C	-	45 43	-	-	-		41
(MH)	STIFF MOTTLED REDDISH BROWN SILTY CLAY W/GRAY CLAY POCKETS										
		15									
			2"S	S-D	110	53 53	72	-	-		5/0.5' 6/0.5'
(CH)	STIFF, GRAY CLAY										
CH	MEDIUM TO STIFF MOTTLED BROWN CLAY W/TRACES OF DECOMPOSED ROCK	20									
			2"SS	S-E	-	58	- LL= 132 PL= 42	-	-		
	END OF BORING @ 21.5'										

NOTE:
LL= LIQUID LIMIT, %
PL= PLASTIC LIMIT, %

*Elev. Estimated from Topographic Survey

SUBDIVISION OF PORTION OF GRANT 563

TABLE I A - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	2	3	3	3
SAMPLE NO.	E		B	C
DEPTH BELOW SURFACE	20'-21.5'	SURFACE	10'-11.5'	15'-16'
DESCRIPTION	MOTTLED DARK BROWN SILTY CLAY W/DECOMP. ROCK	MOTTLED RED-BROWN SILTY CLAY W/GRAY CLAY POCKETS	MOTTLED RED-BROWN SILTY CLAY W/GRAY CLAY POCKETS	MOTTLED BROWN & GRAY SILTY CLAY W/TRACES OF SAND
GRAIN-SIZE ANALYSIS (% Passing) Sieve				
1"		100		
1/2"		100		
#4		98.4		
#10		97.8		
#20		97.4		
#40		96.3		
#100		93.9		
#200		93.1		
ATTERBERG LIMITS				
Air Dried or Natural	NATURAL	NATURAL	NATURAL	NATURAL
Liquid Limit	99	94	97	116
Plastic Limit	45	39	43	47
Plasticity Index	54	55	54	69
Dilatancy	NONE-SLOW	NONE-SLOW	SLOW-MED.	NONE
Toughness	MEDIUM	MED.-HIGH	MED.-HIGH	MEDIUM
Dry Strength	MEDIUM	MEDIUM	MEDIUM	MEDIUM
UNIFIED SOIL CLASSIFICATION	MH	MH-CH	MH	MH
APPARENT SPECIFIC GRAVITY				
EXPANSION AND CBR TESTS (Surcharge-51 P.S.F.)				
Molding Moisture, %		32.9		
Molding Dry Density, P.C.F.		88.8		
Swell upon saturation, %		8.8		
CBR at 0.1" Penetration		2.1		
MOISTURE-DENSITY RELATIONS OF SOILS (AASHO T-180-57 Method ___)		A		
Dry to Wet or Wet to Dry		DRY TO WET		
Max. Dry Density (P.C.F.)		91.2		
Optimum Moisture (%)		30.8		

REMARKS:

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

Date 4-26-73 By BT

SUBDIVISION OF PORTION OF GRANT 5631

TABLE IB - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	3	3		4
SAMPLE NO.	D	E		
DEPTH BELOW SURFACE	15'-16'	20'-21.5'		SURFACE
DESCRIPTION	MOTTLED BROWN & GRAY SILTY CLAY W/DECOMP ROCK	MOTTLED BROWN & GRAY CLAYEY SILT W/DECOMP ROCK		MOTTLED BROWN CLAYEY SILT W/TRACES OF DECOMP. ROCK
GRAIN-SIZE ANALYSIS (% Passing) Sieve				
1"				100
1/2"				100
#4				99.9
#10				99.6
#20				99.2
#40				99.0
#100				98.6
#200				98.4
ATTERBERG LIMITS				
Air Dried or Natural	NATURAL	NATURAL		NATURAL
Liquid Limit	83	78		81
Plastic Limit	42	40		54
Plasticity Index	41	38		33
Dilatancy	NONE	NONE-SLOW		SLOW-MED
Toughness	MEDIUM	MEDIUM		MEDIUM
Dry Strength	SLIGHT-MED.	SLIGHT-MED		SLIGHT-MED.
UNIFIED SOIL CLASSIFICATION	MH	MH		MH
APPARENT SPECIFIC GRAVITY				
EXPANSION AND CBR TESTS (Surcharge-51 P.S.F.)				
Molding Moisture, %				42.3
Molding Dry Density, P.C.F.				76.6
Swell upon saturation, %				1.0
CBR at 0.1" Penetration				13.5
MOISTURE-DENSITY RELATIONS OF SOILS (AASHO T-180-57 Method ___)				
Dry to Wet or Wet to Dry				
Max. Dry Density (P.C.F.)				
Optimum Moisture (%)				

REMARKS:

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

Date 4-26-73 By BT

SUBDIVISION OF PORTION OF GRANT 5631

TABLE I C - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	5	5	5	
SAMPLE NO.	A	B	E	
DEPTH BELOW SURFACE	0.5'-2'	5'-6'	20'-21.5'	
DESCRIPTION	MOTTLED GRAY-BROWN CLAY W/ROOTS	MOTTLED RED, BROWN & GRAY CLAY	MOTTLED BROWN CLAY W/TRACES OF DECOMP. ROCK	
GRAIN-SIZE ANALYSIS (% Passing) Sieve				
1"				
1/2"				
#4				
#10				
#20				
#40				
#100				
#200				
ATTERBERG LIMITS				
Air Dried or Natural	NATURAL	NATURAL	NATURAL	
Liquid Limit	107	112	132	
Plastic Limit	41	39	42	
Plasticity Index	66	73	90	
Dilatancy	NONE	NONE	NONE	
Toughness	HIGH	HIGH	HIGH	
Dry Strength	HIGH	HIGH	HIGH	
UNIFIED SOIL CLASSIFICATION	CH	CH	CH	
APPARENT SPECIFIC GRAVITY				
EXPANSION AND CBR TESTS (Surcharge-51 P.S.F.)				
Molding Moisture, %				
Molding Dry Density, P.C.F.				
Swell upon saturation, %				
CBR at 0.1" Penetration				
MOISTURE-DENSITY RELATIONS OF SOILS (AASHO T-180-57 Method ___)				
Dry to Wet or Wet to Dry				
Max. Dry Density (P.C.F.)				
Optimum Moisture (%)				

REMARKS:

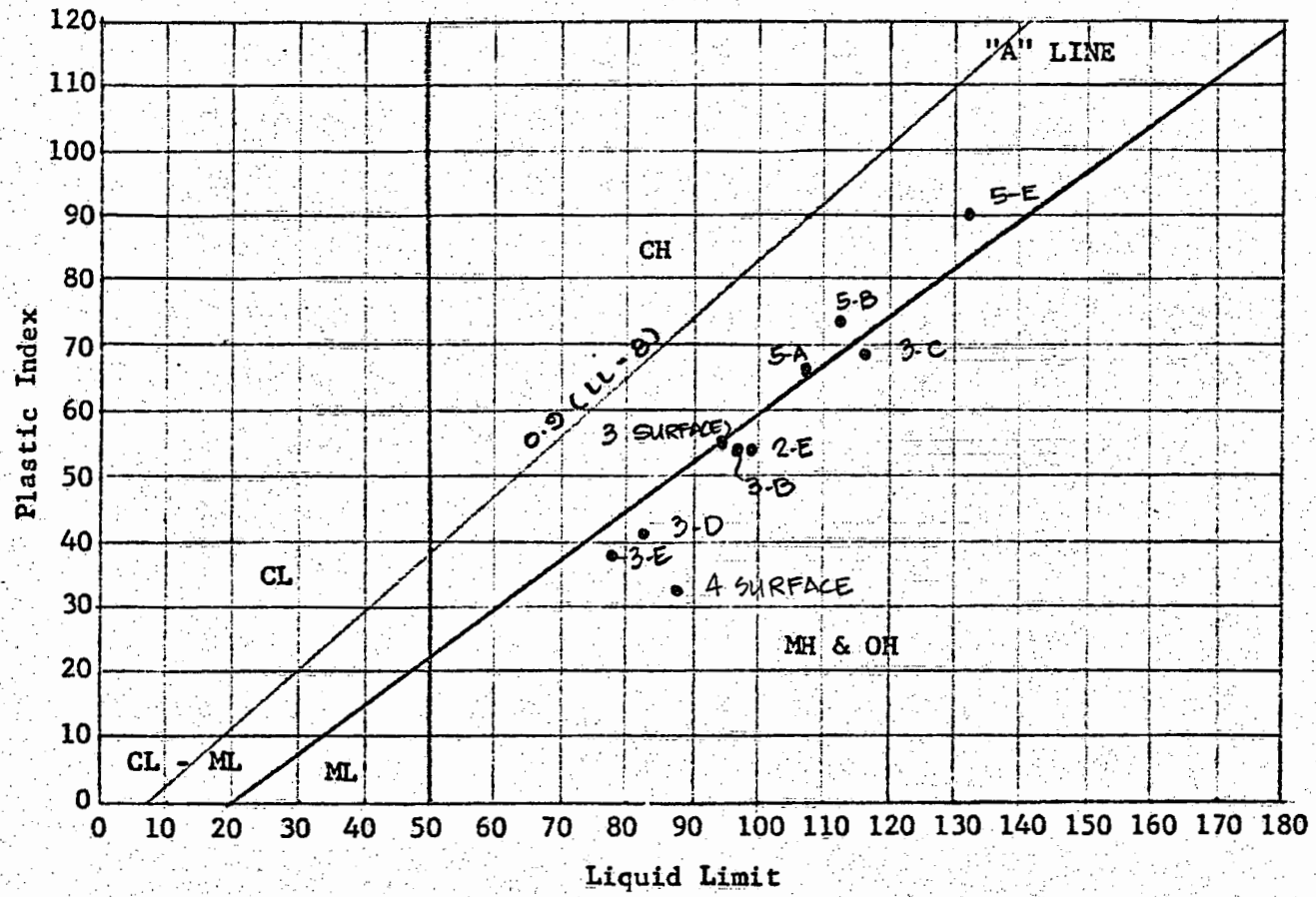
WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

Date 4-26-73 By BT

3-470

JOB: SUBDIVISION OF PORTION OF GRANT 5631

LOCATION: WAIOMAO, PALOLO VALLEY, OAHU, HAWAII



PLASTICITY CHART

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

4-26-73 BT

MOISTURE–DENSITY CURVE (AASHO T-180-57, METHOD A)

PROJECT: SUBDIVISION OF PORTION OF GRANT 5631

LOCATION: PALOLO VALLEY, HONOLULU, HAWAII

SAMPLE NO.: 3 SURFACE

SAMPLE DESCRIPTION: MOTTLED RED-BROWN SILTY CLAY W/GRAY CLAY POCKETS

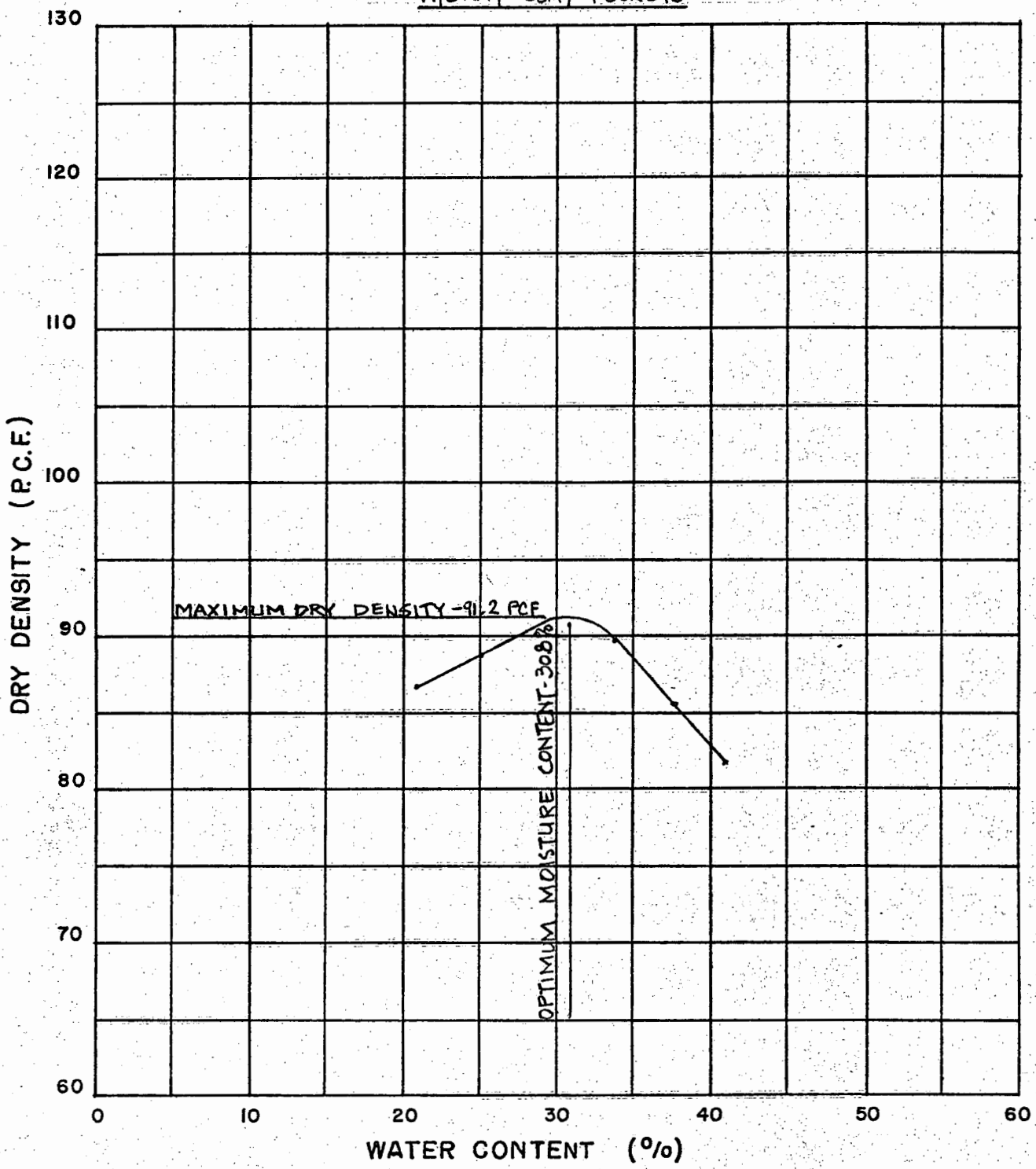
AGGREGATE: 1/4" MINUS

MOLD SIZE: 4" ϕ x 4.584" HIGH

HAMMER: 10 LBS. 18" DROP

LAYERS: 5

BLOWS: -25 / LAYER



WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

DATE 4-20-73 BY JS

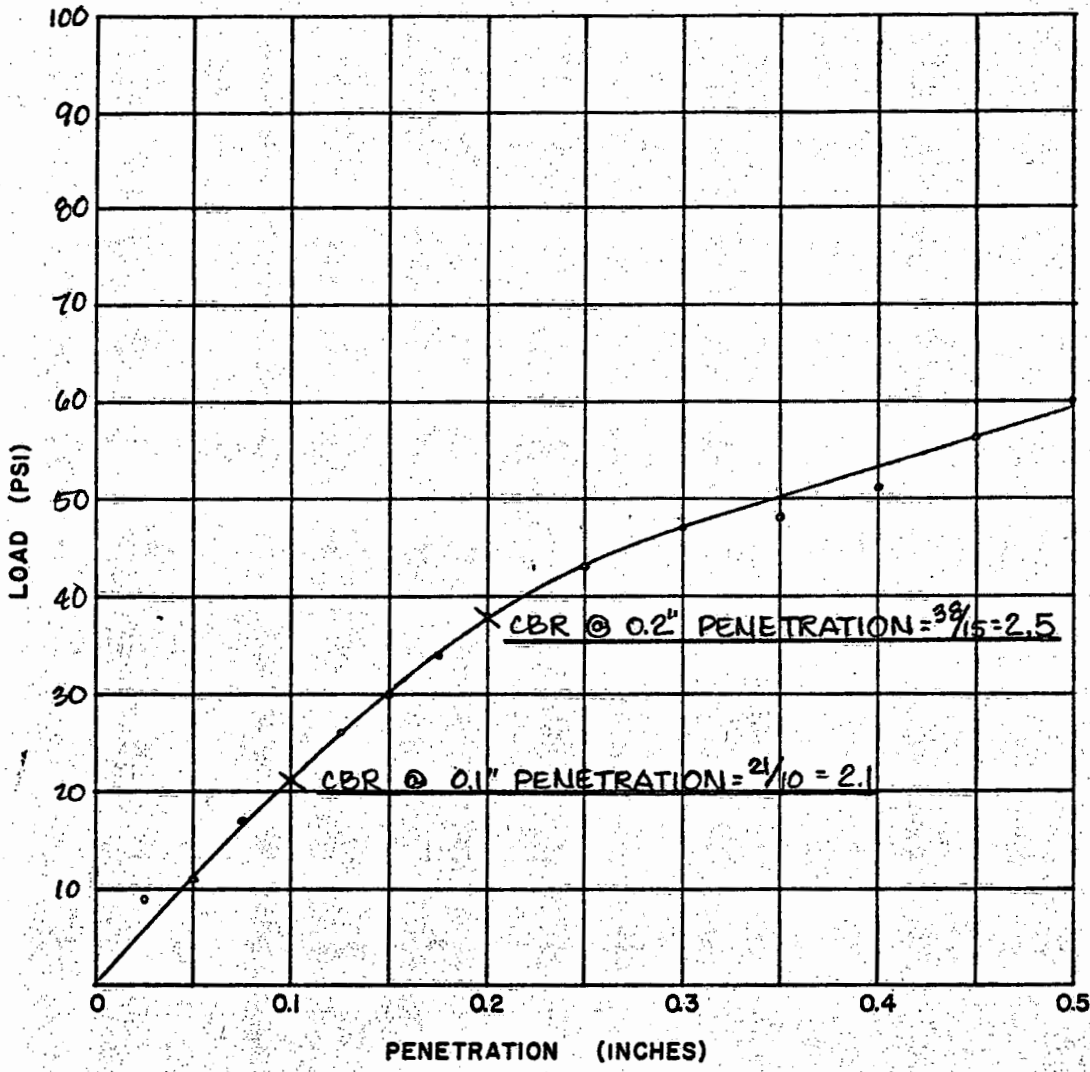
CBR TEST

PROJECT: SUBDIVISION OF PORTION OF GRANT 5631

LOCATION: PALOLO VALLEY, HONOLULU, HAWAII

SAMPLE NO: 3 SURFACE

SAMPLE DESCRIPTION: MOTTLED RED-BROWN SILTY CLAY W/ GRAY CLAY POCKETS



CBR PENETRATION DATA

PENETRATION (INCHES)	LOAD (LBS.)	LOAD (PSI)
0.025	28	9
0.050	34	11
0.075	50	17
0.100	63	21
0.125	77	26
0.150	90	30
0.175	103	34
0.200	115	38
0.250	129	43
0.300	140	47
0.350	143	48
0.400	154	51
0.450	167	56
0.500	180	60

AGGREGATE 1/4" MINUS

HAMMER WEIGHT 10 LBS

HAMMER DROP 18"

No. OF BLOWS 56/LAYER

No. OF LAYERS 5

TEST RESULTS:

MOLDING MOISTURE, %. 32.9

MOLDING DRY DENSITY, P.C.F. 88.8

CBR @ 0.1" PENETRATION 2.1

DAYS SOAKED 5

DATE 4-23-73 BY LY

DATE 4-24-73 BY NI

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

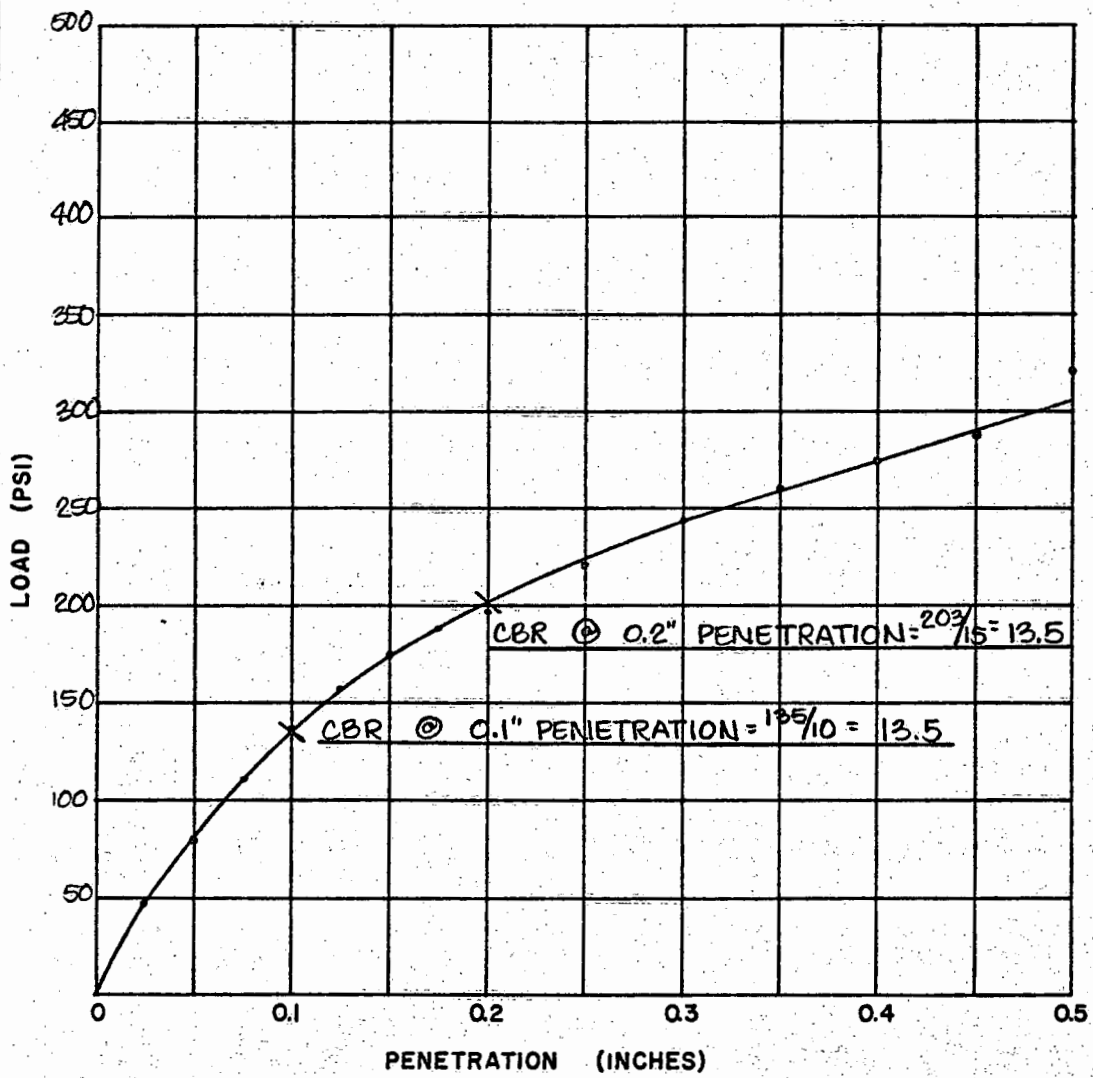
CBR TEST

PROJECT: SUBDIVISION OF PORTION OF GRANT 5631

LOCATION: PALOLO VALLEY, HONOLULU, HAWAII

SAMPLE NO: 4 SURFACE

SAMPLE DESCRIPTION: MOTTLED BROWN CLAYEY SILT W/TRACES OF DECOMP. ROCK



CBR PENETRATION DATA

PENETRATION (INCHES)	LOAD (LBS.)	LOAD (PSI)
0.025	140	47
0.050	240	80
0.075	330	110
0.100	410	137
0.125	470	157
0.150	520	173
0.175	560	187
0.200	590	197
0.250	660	220
0.300	730	243
0.350	780	260
0.400	820	273
0.450	860	287
0.500	930	320

AGGREGATE 1/4" MINUS

HAMMER WEIGHT 10 LBS

HAMMER DROP 18"

No. OF BLOWS 56/LAYER

No. OF LAYERS 5

TEST RESULTS:

MOLDING MOISTURE, %. 42.3

MOLDING DRY DENSITY, P.C.F. 76.6

CBR @ 0.1" PENETRATION 13.5

DAYS SOAKED 5

DATE 4-18-73 BY BS & EM

DATE 4-19-73 BY NI

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

LIMITATIONS

In general, soil formations are commonly erratic and rarely uniform or regular. The boring logs indicate the approximate subsurface soil conditions encountered only at the drill holes where the borings were made at the times designated on the logs and may not represent conditions at other locations or at other dates. Soil conditions and water levels may change with the passage of time and construction methods or improvements at the site.

During construction, should subsurface conditions much different from those in the borings be observed, encountered, or otherwise indicated, we should be advised immediately to review or reconsider our recommendations in light of the new developments.

If there is a substantial lapse of time between the submission of this report and the start of work at the site, or if conditions have changed due to natural causes, plan changes, or construction operations at or adjacent to the site, it is recommended that this report be reviewed to determine the applicability of the recommendations considering the time lapse and the changed conditions.

Our professional services were performed, findings obtained and recommendations prepared in accordance with generally accepted engineering practices. This warranty is in lieu of all other warranties expressed or implied.